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APRIL 2019

The Organic Truth: What 22 Years of Monitoring Reveals About Forest Soil Resiliency on the Kootenai National Forest

Once Disturbed, Always Disturbed?

It is impossible to avoid disturbing the forest when harvesting timber. Trees are felled, and soil is compacted beneath heavy equipment during harvest operations. Yet on many sites, the landscape recovers. A year later, a future forest may already be growing, with saplings and shrubs reclaiming the open ground. Even the soil recovers, as the results of a 22-year monitoring study in western Montana have shown. This finding is contrary to what was the accepted assumption, that compacted soils take a long time to recover, if at all, which in turn affects forest productivity.

Collecting soil samples from 1992 through 2006, and again at the same sites in 2012–2013 allowed researchers and managers to document the soil's recovery and how fast it had recovered at harvest and control sites. Key factors related to soil recovery were soil texture and organic matter content (photo K. Anderson).

Studying Soils Requires Patience and Getting Your Hands Dirty

Deborah Page-Dumroese, a research soil scientist with the Rocky Mountain Research Station, has spent her career studying the impact of timber harvest activities on soils. She is the lead author of the Forest Soil Disturbance Monitoring Protocol, which was adopted as a U.S. Forest Service standard method in 2009. When presented with the opportunity to work with Kootenai National Forest scientists John Gier, Kenneth Kindel, and Louis Kuennen to synthesize results of a long-term soil monitoring effort to determine soil recovery after timber harvesting and subsequent fuels treatments, Page-Dumroese welcomed the opportunity.

For researchers wanting to observe the recovery of landscapes after a disturbance, patience is required because data collection can span years and even decades to detect change and longer-term trends. On

KEY FINDINGS

- Soil texture and organic matter content greatly influence how soils recover from a disturbance. High organic matter is positively correlated with resilience.
- Over 80 percent of the harvest units showed soil recovery following a timber harvest years later. Only 9 percent did not recover, while some units had 100 percent recovery.
- Root growth, freeze-thaw cycles, and soil fauna contribute to soil recovery from compaction.
- Using harvest equipment and methods that reduces forest floor compaction decreases soil disturbance that affects tree growth.

183 plots located within the Kootenai, Gier and his team collected soil samples from harvest units between 1992 through 2006, and again in 2012-2013. On each long-term plot, the soil was categorized as undisturbed, moderately disturbed, or heavily disturbed. By collecting samples from the same location years apart, they could determine recovery rates and how fuels treatment and soil type affected recovery.

After 22 years, 86 percent of the long-term plots showed reduced soil disturbance, and some units even had 100 percent soil recovery. Organic matter was a significant factor responsible for this observed recovery, along with an active freeze-thaw cycle, root growth, and presence of soil fauna. Page-Dumroese recalled being surprised by the results. "There are older studies conducted on soil similar to those in western Montana that said soil recovery could take up to 40 years or more," she explained. "We saw recovery happening in the first five to seven years after harvest."

Rethinking Our Assumptions About Soil Resilience

Page-Dumroese considers long-term monitoring studies such as this an immediately valuable tool for adaptive management. "You can't really adapt if you don't learn from what you've done," she said. "This research project is a great example of how we can learn from monitoring data." For example, on the Kootenai National Forest, forest managers can better identify when, where, and what equipment type should be used for future harvest operations based on soil type and other factors.

"We now recognize that soil properties and recovery from compaction are different across the landscape," Page-Dumroese said. "Productive sites are usually resilient to harvesting, but sites without a lot of organic matter are not. Just knowing that is a key management consideration."

These soil samples from the same harvest unit show the difference between undisturbed and disturbed soil. The soil in photo A contains deep roots and understory vegetation, while the soil in photo B, has little vegetation and the top layer is compacted, as a result of the excavator (photo by J. Gier, U.S. Forest Service).

FURTHER READING

Gier, John M.; Kindel, Kenneth M.; Page-Dumroese, Deborah S.; Kuennen, Louis, J. 2018. Soil Disturbance Recovery on the Kootenai National Forest, Montana. Gen. Tech. Rep. RMRS-GTR-380. Fort Collins, CO: U.S. Department of Agriculture, Forest Service Rocky Mountain Research Station. 39 p. www.fs.fed.us/rmrs/publications/soil-disturbance-recovery-kootenai-national-forest-montana

Page-Dumroese, Deborah S.; Abbott, Ann M.; Rice, Thomas M. 2009. Forest Soil Disturbance Monitoring Protocol: Volume I: Rapid assessment. Gen. Tech. Rep. WO-GTR-82a. Washington, DC: U.S. Department of Agriculture, Forest Service. 31 p. www.fs.fed.us/rmrs/publications/forest-soil-disturbance-monitoring-protocol-volume-i-rapid-assessment

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